

# Design a Lab

## Teacher Directions

This activity is designed to help students learn the characteristics of a good research question. A good research question is key to the design of a good lab. This activity is suitable to assign as a group task, a brain storm session for the full class, a Think-Pair-Share or as an individual task depending upon the students' experience with designing labs. However the activity is presented in class, students should complete the task by submitting an individual written version. Ideally students would be allowed to carry out their lab design by conducting the lab. If possible it would be helpful to have the students exchange lab designs and complete the lab using a classmate's instructions. They can then provide feedback to the author using a rubric. Suggestions for the rubric are included below.

## Student directions

### Design a lab

For this activity you are to design a lab to test the following question.

Does mowing affect weed growth?

1. In the question above there are four underlined words. These words are underlined because they are not clear enough to make a good starting point for a lab design. Before you can design the lab you must improve the question. You are required to fix the problem statement above by first defining precisely the underlined words.

Define is a command term that means to give a precise meaning of a word, phrase or physical quantity. It is sometimes helpful with a definition to provide an example if possible.

- a) Define precisely the term "mowing". (Hint: how often, how, to what height?)
  - b) Define precisely the word "affect".
  - c) Define precisely the term "weed".
  - d) Define precisely the term "growth".
  - e) Rewrite the problem statement as a research question. Use the precise meanings you have developed.
2. You have access to two areas in the same geographic location, one of which is mowed according to your definition above and one of which is never mowed.

The command term outline requires you to give a brief outline or summary, while state asks you to give a specific name, value or other brief answer without explanation or calculation. Describe requires you to give a detailed account.

- a) Outline the experiment you would do to test your problem statement from question 1.
- b) State your independent (manipulated) variable and describe how it is varied between the two sites.

c) State your dependent (responding) variable. Describe how you will measure it.

d) State any controlled variables in your experiment and describe how they are going to be held constant and how you will monitor them.

## Support material

### Markschemes/marketing notes:

1.

a) Define precisely the term "mowing". (Hint: how often, how, to what height?)

Complete answer will define mowing as cutting the grass and associated vegetation to a named height at a specified frequency, and may also describe the type of mower.

Partial answers will address either the named height or the frequency.

Insufficient answers will fail to address either or will fail to specify for both.

b) Define precisely the word "affect".

Complete answers will predict either an increase or decrease in growth which they may have defined as an increase in density, dispersion, abundance per unit area.

Insufficient answers will fail to predict the direction of change.

c) Define precisely the term "weed".

Complete answers will name a specific species (family or genus is acceptable) to be monitored.

Partial answers may define the term weed as undesirable species or give a common example.

Insufficient answers will fail specify an example or will define weed as those species not grass.

d) Define precisely the term "growth".

Complete answers will state a parameter that can be quantified such as plant density or plant abundance.

Insufficient answers may include trivial measures such as height, biomass etc. as they would obviously be impacted by mowing and do not speak to mowing as a weed control mechanism.

e) Rewrite the problem statement as a research question. Use the precise meanings you have developed.

Complete answers will include the precise variables that the student has defined.

Partial answers can be awarded if one of the variables is not specified but the second variable is.

Insufficient answers fail to quantify in a meaningful way either dependent or independent variable.

2.

You have access to two areas in the same geographic location, one of which is mowed according to your definition above and one of which is never mowed. The command term outline requires you to give a brief outline or summary, while state asks you to give a specific name, value or other brief answer without explanation or calculation. Describe requires you to give a detailed account.

a) Outline the experiment you would do to test your problem statement from question 1.

Complete answers will provide an outline that gives a procedure that could be followed to test the research question posed by the student. It should indicate how data will be collected, what data will be collected, how many replicates will be undertaken, how the sampling areas will be selected, what parameters they will try to keep constant between the two areas, any other reasonable answers.

Partial answers will outline the information contained above but maybe incomplete or missing 2 or more of the characteristics listed for a complete answer.

Insufficient answers will outline half or less of the above information.

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b) State your independent (manipulated) variable and describe how it is varied between the two sites.

Complete answers include a correct statement of their independent variable and describes the level(s) of manipulation.

c) State your dependent (responding) variable. Describe how you will measure it.

Complete answers include a correct statement of the dependent variable and describes measurement in terms of how it is quantified and measured (i.e. transects, quadrants, census counts etc.).

d) State any controlled variables in your experiment and describe how they are going to be held constant and how you will monitor them.

Possible controlled variables may include slope and aspect of transects, the amount of rainfall, other treatments such as spraying of herbicides, fertilizing, species of grasses etc. that provide competition, any other reasonable answers.

Complete answers will state and correctly describe at least two or more of these possible characteristics.

Partial answers will state and correctly describe at least one controlled variable for this experiment.

Insufficient answers fail to state and describe one controlled variable.

### Rubric:

#### Lab Design Instructions Assessment Rubric

Place a check in the column that best describes the criteria for the lab instructions you were given. If you had to ask for clarification from the author rewrite the instructions so that they can be carried out without clarification from the author.

Criteria	Not at all	Partial	Complete
Instructions were clear and easy to follow.			
The instructions were detailed enough that I could follow them without needing clarification from the author.			
I had enough information to identify the plants that the design considered a weed			
The instructions would result in my collecting enough data (5 or more samples).			
The instructions were sequential (in order).			

## Design a Lab

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Subject:

Biology

DP Component & Criteria:

A. Design

Component type:

Internal

MYP Criteria:

Group 4 / Sciences